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## Duodenal Volvulus In Free-Living Green Turtles From Coastal United Arab Emirates

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**ABSTRACT:** Post-mortem examinations performed during May and August of 1997 on three free-living green turtles (*Chelonia mydas*) in the United Arab Emirates revealed that all had stomachs full of fresh seagrass (approximately 99% of the total ingesta) and presented with a duodenal volvulus involving a length of approximately 100 cm. Duodeni appeared empty and necrotic with diffuse purple-black mucosa. No apparent signs of obstruction by foreign objects, acute endoparasitism, or other disorders were observed. In all cases, duodenal volvulus was diagnosed, the cause of which may have been dietary in origin. The rise in water temperature, with an associated rise in the temperature of seagrass, thus enhancing the over-fermentation of ingesta with the subsequent liberation of excessive amounts of gas was the probable cause of volvulus formation. Ingestion of foreign bodies and physical movement also are discussed as causes of digestive disorders. It is recommended that handlers should avoid 360° rotation when overturning turtles onto their carapaces.

**Key words:** Case histories, *Chelonia mydas*, duodenum, green turtle, seagrass ingesta, volvulus.

Green turtles (*Chelonia mydas*) are marine herbivores, consuming mainly seagrass and, to a lesser extent, algae (Mortimer, 1995). The average amount of seagrass consumed by this species per annum is 100 kg dry weight in the Caribbean (Bjørndal, 1980). Similar values, which will be fully described elsewhere, have been documented in the Arabian Gulf (United Arab Emirates). Volvulus has been widely documented in small monogastric domesticated animals, and in large domesticated herbivores (McCurnin, 1994; Vanhoogmoed and Snyder, 1996; Glickman et al., 1997) but only once in marine mammals (Anderson and Rawson, 1997). Volvulus in herbivores is relatively common and it is characterized by the twisting of a section of the intestine on its mesenteric axis. This condition is normally associated with the

overproduction of gas, ingested foreign bodies, or physical movement. This report presents the post-mortem findings on three green turtle carcasses found stranded in Ras Al Khaimah (RAK), United Arab Emirates (UAE).

Ras Al Khaimah is one of the seven emirates composing the UAE, located on the northeast of the country (25°42'53"N and 55°47'45"E). Its coastline is characterized by inshore sandy beaches free of natural breakers, offshore sandy arms that run parallel to the coast, and shallow coastal lagoons with intertidal mudflats. Seagrass meadows, consisting of *Halodule uninervis* and *Halophila ovalis*, sandy shoals, and algal and coral beds are common benthic ecosystems present in the area.

The recently created Environmental Research and Wildlife Development Agency (ERWDA) of the UAE initiated a sea turtle research and conservation program throughout the UAE. As a component of these efforts, a survey of stranded sea turtles off the coast of RAK covering approximately 35 km was undertaken between 29 April and 29 May 1997 and between 27 July and 2 August 1997. Twenty carcasses were found and included 17 green turtles, two logger head turtles (*Caretta caretta*), and one hawksbill turtle (*Eretmochelys imbricata*). Only 10 carcasses were fresh enough for adequate post-mortem examination, all of which were green turtles. Seven of these had been killed for their eggs. The other three presented with duodenal volvulus.

The first case was an adult female green turtle carcass with a curved carapace length (CCL) of 101 cm, curved carapace width (CCW) of 90 cm, straight plastron to tail length (SPT) of 24 cm, and straight plas-

tron to cloaca length (SPC) of 17 cm. Upon post-mortem analysis, the complete plastron was removed as described by Rainey (1981). The coelomic cavity was free of intraperitoneal fluids. The anterior and pyloric stomachs appeared full; the anterior stomach wet weight was 3 kg (286 g dry weight). The stomach contents were composed almost exclusively of fresh seagrass consisting of *H. uninervis* (87%) and *H. ovalis* (12%). Algae, mollusks, and benthic detritus represented only 1% of the total contents. A clear twist, posterior to the pyloric sphincter, was evident. At the position of the twist, a sharp division was clearly marked between normal tissue of pale-yellow color and a tissue of purple-black color. All of this section was necrotic and empty, presenting thick, diffusely black mucosa covering a length of approximately 1 m. Posterior to this section, the tissues sharply regained their normal intestinal color, where partially digested seagrass was present. The large intestine contents consisted of normal soft and hard fecal material. There were no apparent signs of acute endoparasitism or obstruction. Fecal pellets in the rectum were 5 cm long. The remainder of the viscera appeared normal.

The second case involved an adult male green turtle with 93 cm CCL, 81 cm CCW, 49 cm SPT, and 37 cm SPC. Upon post-mortem examination, similar findings to the first case were observed. When analyzing the digestive system, the stomach contents consisted of fresh seagrass *H. uninervis* (97%), *H. ovalis* (2%), and algae, mollusks and benthic detritus (1%). No foreign obstructive material was found. A volvulus was clearly observed behind the pyloric sphincter, extending 125 cm posterior. No apparent signs of endoparasitism were observed. All other systems appeared normal, with the exception of a hemorrhagic right lung and pectoral muscles.

The third case was a subadult female green turtle with 88 cm CCL, 76 cm CCW, 21 cm SPT, and 14 cm SPC. Along the midline of the carapace, the vertebrae appeared separated from the coastal

plates, probably due to extreme gaseous pressure within the body cavity. Upon examination, the oesophagus, stomach and pyloric stomach were full of fresh sea grass (89% *H. ovalis* and 11% *H. uninervis*). Organs from all systems appeared normal with the exception of the duodenum which presented with a thick black mucosa posterior to the pyloric sphincter and extended for approximately 75 cm. Again a clear volvulus was evident behind the pyloric sphincter. The duodenum had ruptured prior to examination (Figs. 1, 2). The rest of the digestive system appeared normal with the exception of some sections posterior to the duodenum which were distended and full of gas.

In all these cases, duodenal volvulus was diagnosed, the cause of which was likely to have been dietary in origin. In addition, the reported conditions were characterized as acute because the individuals were feeding before death. It was estimated that all three individuals died within 72 hr of volvuli formation.

Most sea turtles from RAK occur along offshore sandy arms that divide the open coastal waters from those of a shallow lagoon. This area, extending approximately 5 km in length and located between Al Hamrah and RAK city, is constantly being filled and emptied by tidal action (1.5 m tidal range). Seagrass (*H. uninervis*) grows at a depth as shallow as 50 cm (low tide) in this lagoon. At high tide, green turtles enter the lagoon to feed and return to open waters with receding tides. The water temperature in this coastal ecosystem increases as tides recede and because of the extreme climatic conditions existing in the Arabian Gulf.

Spring temperatures during March range between 19 and 22 C. Summer temperatures in July have been documented in the range of 31 to 33 C in open waters. However, in shallow lagoons water temperature rises significantly (Miller, 1989). Temperatures recorded from the study area, on the open beach front near this lagoon averaged 27.5 C in May and 35.5 C in August.



FIGURE 1. Stomach and small intestine from the green sea turtle, (*Chelonia mydas*) described in case three from Ras Al Khaimah, UAE. The anterior stomach (A) and pyloric stomach (B) consist of pale yellow, healthy tissue while the duodenum (C) shows clear necrosis. The arrows indicate the position of the two sphincter muscles. The volvulus was evident posterior to the pyloric sphincter (second set of arrows) and extended 75 cm along the duodenum. Note that the volvulus is not visible because the duodenum was untwisted during the dissection. However, the impact of the volvulus is evident from the rupture of the duodenum. The white convex lines delimit the section of the intestines depicted in Figure 2. Bar = 20 cm.

Salinity also varies seasonally, being higher in the summer months as a result of water evaporation. Average salinity levels range from 37 to 40 parts per thousand in the central areas of the Arabian Gulf, 40 to 50 parts per thousand in the shallow waters, and in very shallow lagoons may

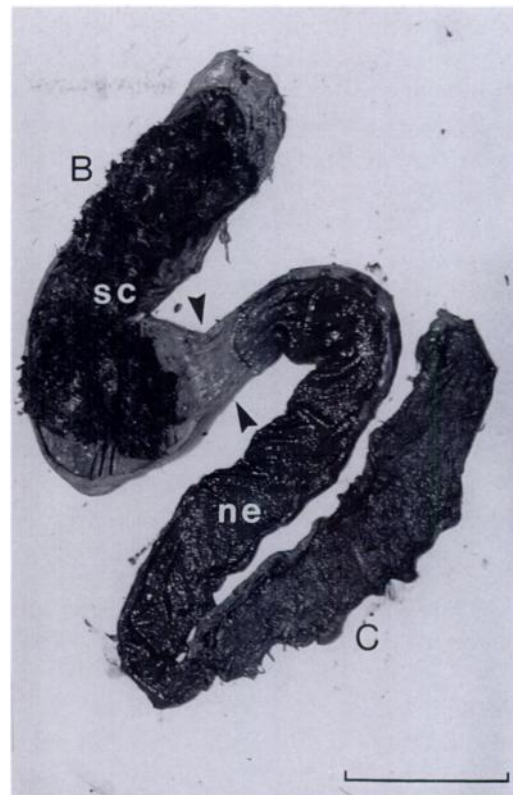


FIGURE 2. Dissection along the length of the pyloric stomach and duodenum exhibiting a volvulus from the same green sea turtle seen in Figure 1. The stomach contents (sc) of the pyloric stomach (B) consist of fresh sea grass. This contrasts with the duodenum (C) which was empty and consisted of purple-black necrotic (ne) tissue. The arrows indicate the position of the pyloric sphincter. Bar = 20 cm.

reach up to 200 parts per thousand (Basson et al., 1997).

It is possible that due to the prevalent environmental conditions along the coastline of RAK, the temperature of seagrass also may rise. This could result in the over-fermentation of ingesta in turtles with the subsequent liberation of excessive amounts of gas; a disorder widely observed in captive non-domesticated and domesticated herbivores. This condition could trigger intestinal torsion representing a probable cause of the volvuli being reported.

Sea turtles are commonly found stranded on beaches in the Arabian region, but little or no systematic effort has been

made to establish the causes of death (Brown, 1985; Gasperetti et al., 1993). In this study, of the 10 individuals examined, only three turtles died of natural causes, all attributed to intestinal volvulus. In view of this finding, it is possible that the prevalence of natural deaths among green turtles in the Arabian Gulf due to digestive disorders is high. However, most sea turtle carcasses were too decomposed to allow full post-mortem examination, making it difficult to evaluate the possible cause of death.

The only other case of volvulus reported is from a captive adult male hawksbill turtle whose death was associated with clostridial toxemia and to a volvulus generated by the impactation of foreign bodies (Schumacher et al., 1996). Foreign bodies are accidentally ingested by sea turtles and may cause obstruction of the digestive system (Frye, 1991). Obstructions of the small intestine lead to a rapid death due to severe loss of water and electrolytes. This can further cause a volvulus, blocking the venous return from the affected section (Schumacher et al., 1996).

Volvulus, in large chelonians, also can be induced by physically turning the animal over for restraint purposes. If these individuals are turned to their up-right position but on opposite sides, so as to rotate 360°, then volvuli formation could be enhanced. When turtles are manipulated in this way, the intestines are prone to twist due to their large mass of contents. This condition has been observed in captive large chelonians of the genus *Geochelone* (J. Samour, pers. observ.). Consequently, turning these animals on their backs is not advisable. However, if turned, care should be exercised on returning turtles back from their opposite side as to avoid a 360° turn.

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